**Assignment no.1:**

**Miscellaneous Issues: Psychological Scaling**

**Submitted to:**

**Dr. Fatima Nazim Bukhari**

**Submitted by:**

**Rabia Javed Bhatty**

**Roll. No: 14**

**PhD. Applied Psychology**

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**Department of Applied Psychology**

**The Islamia University of Bahawalpur, Pakistan**

**Miscellaneous Issues: Psychological Scaling**

**Levels of Measurement**

Variables can be split into categorical and continuous, and within these types there are different levels of measurement:

* **Categorical (entities are divided into distinct categories):**
* **Binary variable:**

There are only two categories (e.g. dead or alive).

* **Nominal variable:**

There are more than two categories (e.g. whether someone is an omnivore, vegetarian, vegan, or fruitarian).

* **Ordinal variable:**

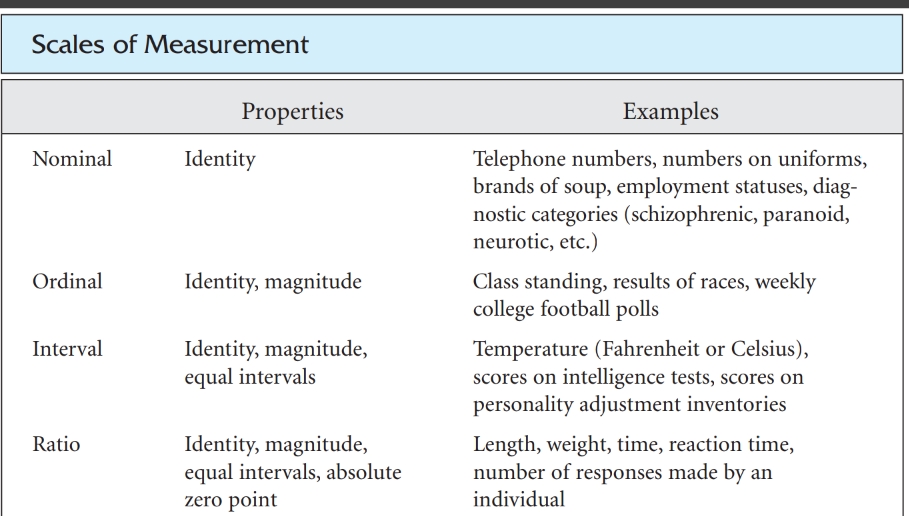
The same as a nominal variable but the categories have a logical order (e.g. whether people got a fail, a pass, a merit or a distinction in their exam).

* **Continuous** (entities get a distinct score):
* **Interval variable:**

Equal intervals on the variable represent equal differences in the property being measured (e.g. the difference between 6 and 8 is equivalent to the difference between 13 and 15).

* **Ratio variable:**

The same as an interval variable, but the ratios of scores on the scale must also make sense (e.g. a score of 16 on an anxiety scale means that the person is, in reality, twice as anxious as someone scoring 8).



■ **Nominal Measurement**

Nominal (sometimes called categorical) measurement occurs when people are simply placed into different categories. This form of measurement is a classifying or naming activity (hence the term nominal). For example, you can classify your research participants as men or women, as right-handed or left-handed, as Catholic or Protestant. The differences between categories are of kind (qualitative) and not of degree (quantitative). In many research problems, it is sufficient to determine simply whether the number of individuals in a given category varies as a function of some treatment in which you are interested. For example, you might want to determine whether a particular type of advertising alters the percentage of people willing to try a new product. Your behavioral measure would then be whether an individual is willing to try a new product. Numbers themselves sometimes can be used as nominal categories. For example, the numbers on baseball jerseys, telephone numbers, and ZIP codes illustrate nominal uses of numbers, as do coding data (for example, male= 1, female= 2).

**■ Ordinal Measurement**

In the case of ordinal measurement, a single continuum usually underlies a particular classification system. College football standings, pop-music charts, and class standings are examples of ordinal measurements. In a psychological experiment, you might divide up your research participants on the basis of creativity and end up with three categories: noncreative, creative, and highly creative, which can be given the values 1, 2, and 3, respectively. These scores reflect an underlying continuum: the relative amount or magnitude of creativity. An ordinal scale represents some degree of quantitative difference, whereas a nominal scale does not.

Ordinal scales can be obtained whenever you rank research participants or events along a single dimension. With ordinal measures you are making statements only about order; the differences between consecutive values are not necessarily equal. Notice that numbers used in ordinal measurement have no mathematical properties other than providing categories and rank. Nothing is implied about the magnitude of the intervals between the categories. For example, in the case of the top 20 football teams, there is no assumption that the difference in excellence between the number 1 team and the number 4 team is the same as that between the number 6 team and the number 9 team. Furthermore, it does not make sense to say that the number 1 and 4 teams together equal the number 2 and 3 teams. What we are really doing is transforming information expressed in one form to that expressed in another. For example, think of the food that you ate for supper last night. One way of presenting this information is to name the foods: pizza, soft drink, salad, green stuff (no one really knows what green stuff is, but every college cafeteria has a large supply of it). We can take this list of food and transform it into numerical representations. One simple method uses the property of identity.

We can assign numbers to our food items to identify or distinguish single foods or groups. For example, we might let 1 represent all food that we feel better after eating and 0 stand for all food that we feel worse after eating. Pizza, soft drink, and salad would get a 1, and green stuff would get a 0. We have mapped the aspects of one set onto another set. All this means is that we have found another way (other than just listing) to represent our data. This is not the only way that we can represent our data, however. We could also assign numbers to refer to how much we like the food. We could assign pizza a 1, salad a 2, soft drink a 3, and green stuff a 4. We have now presented the data in terms of the characteristic of magnitude. From this you know that pizza is ranked higher than a soft drink, but, as with a list of finishers in a race, you do not know anything about how much distance exists between them.

* **Interval Measurement**

In interval measurement the scale values are related by a single underlying quantitative dimension (like ordinal data), and there are also equal intervals between consecutive scale values. Equal intervals means that there are equal amounts of the quantity being measured between every two successive numbers on the scale. Thus, on an interval scale, the interval between 1 and 4 equals the interval between 6 and 9. The household thermometer is an example of an interval scale. The degree lines are equal distances apart and reflect equal volumes of mercury; the difference between 20 and 40 is equivalent to the difference between 50 and 70. When we say it is 0 outside, we do not mean that there is no temperature; we mean only that 0 is assigned a certain place on the scale.

* **Ratio Measurement**

In ratio measurement, scores are related by a single quantitative dimension (as with interval or ordinal measurement). Also, they are separated by equal intervals (as with interval measurement), and there is an absolute zero. The most common ratio scales are found in the measurement of the physical attributes of objects, such as weight or length. There is no length shorter than 0 inches, no weight lighter than 0 pounds.

For example, if we were to represent our list of foods according to calorie content, we would know that the relationship between the 300-calorie salad and the 150-calorie soft drink was the same as that between the 300-calorie salad and the 450-calorie pizza; there is a 150-calorie difference between each pair. We could also describe the food in terms of nutritional value, such as its ability to support life or its vitamin content. As you begin to make this mapping, you realize the need to have an absolute zero point. There is no way that green stuff could ever support life, much less contain vitamins. Thus, we could use numbers to represent the amount of a particular vitamin in the food. Pizza might have 33 units, the soft drink 12 units, salad 52 units, and of course, green stuff would have 0 units. Zero in this case means that the vitamin is not present at all; 0 represents an actual quantity.

***Miscellaneous Issues in Psychological Scaling***

* **How to** **Identify Scales of Measurement**

Frequently, the scale of measurement depends on the device (for example, scale or questionnaire) used for measuring the particular concept being studied. Even clear examples from the physical sciences (for example, temperature or length) that are normally viewed as being an interval or ratio measure could not be so called if the measuring instrument itself were not well constructed.

In turn, the design of the measuring instrument depends on a theoretical understanding of the underlying concept. For example, until the development of the kinetic theory of heat, the measurement of temperature was inconsistent. There were many devices, each giving different results that could not be converted from one scale to another as they can now (for example, Celsius to Fahrenheit). Once a theoretical description of heat was developed, the problems of measurement were reduced. This may also be the case in psychology, with our many concepts lacking well-developed theory (for example, anxiety or intelligence).

Scales of measurement are related to how a particular concept is being measured and the questions being asked. For example, if we were to record the order of finish in a marathon, we would have an ordinal scale, whereas if we were to record times for the race, we would have a ratio scale. We must also consider the relationship between physical measures and psychological characteristics. That is to say, a 100-watt light bulb may not be perceived to be twice as bright as a 50-watt one even though twice as much energy is being used. Similarly, recording times during a race is clearly a ratio scale, but that does not necessarily mean that running ability as measured by times during a race is. Thus, we need to both be aware of the nature of our measurements and consider the constructs that we are attempting to understand. We begin with the numbers and note that the devices that measure these should be both reliable and valid.

* **Measurement Scales and Statistics**

Mitchell (1986) tried to place the question of measurement scales and statistics in a historical and a philosophical context. He suggested that there are different theories or paradigms of measurement. For example, when we were in college taking methods courses, it was commonly taught that a direct relationship existed between the particular scale of measurement (nominal, ordinal, interval, or ratio) that we were using and a statistic (for example, t test or sign test) that was appropriate to use with it.

Stevens introduced this idea, along with the idea of scales of measurement, in the 1940s (Stevens, 1946). The basic idea as traditionally taught is that the statistics used must be appropriate to the scale of measurement used. Statisticians, as well as present-day experimentalists, no longer hold this view, and they continually point out that where a number comes from does not determine the appropriate statistical test.

Gaito (1980) has presented a brief but clearly stated review of this issue. The main point is that no statistical reason exists for limiting a particular scale of measurement to a particular statistical procedure. The numbers do not care what you do to them.

Lord (1953) illustrated this in a humorous manner with football numbers on the backs of players’ jerseys. One could find the mean of all the players’ numbers on a football team, but keep in mind that, as Lord pointed out, “the numbers do not remember where they came from.” Like a computer, a statistical technique does not care what numbers it uses or where the numbers come from. Numbers are numbers as far as a computer or statistic is concerned.

However, if you want to make reasonable conceptual decisions based on your numbers, then you must be concerned about where your numbers came from, and this is an issue of measurement, not statistics. To this end, some researchers make a pragmatic distinction between qualitative measures and quantitative measures.

Using measurement theory, we try to assign numbers in a manner in which we can make sense out of what we are doing. But to restate, your statistics do not know and do not care where your numbers come from. It does not matter to a statistic whether your numbers mean what you claim they do, much less whether your experiment was performed well or poorly. However, as a researcher you should care greatly about your inferences and logic.

**References**

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